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PETERSON BUILDERS INC.

FY-82 LABOR STANDARDS PROGRAM

PIPE FABRICATING AND BLAST & PAINT SHOPS

TASK ES-8-14

Conducted at:

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FINAL REPORT

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I. INTRODUCTION

The 1982 Labor Standards Application project (ES-8-14) proposal submitted and accepted provided for the application of engineered labor standards to work performed 1) by the crafts in the Pipe Fabricating Shop and the Electrical Shop and 2), by the electricians aboard ships. Labor standards were to impact upon Scheduling, Planning, manloading, and performance monitoring.

The intent to continue application of labor standards uninterrupted from completion of the PGG Contract into the ARS-50 program required adjustment due to protracted contract delays.

While peterson Builders (PBI) intended to utilize the sequency for applying labor standards described in the proposal (i. e., pipe fabricating shop, electrical shop, and installation areas), contract delays and a resulting lack of work necessitated the requests for and approval of the following modifications:

- 1) A no-cost extension of the FY-82 labor standards data program contract to August 15, 1983, and continued access to the H.B. Maynard "MOST" Computer System for the same period.
- 2) An authorized substitution of work involving commencement of a portion of the FY-83 work (application of labor standards in the blast and

paint booths) in lieu of the originally Proposed application of labor standards to pipe installation aboard ship.

- 3) Intent to apply labor standard data in both electrical and blast/paint booth areas in Phase IV of the SP-8 program.
- Prior to deferring installation of labor standards in the electrical craft area to the FY-83 program, pre-installation work was conducted. Charts and pick off sheets were developed during this time to accommodate detailed analysis and "categorization" of ship board electrical systems data. Monthly Project Progress Reports continued to include status conditions on the" electrical area until midway through the FY-82 program. At this time, conditions warranted deferring installation of labor standards in the electrical area, and contract emphasis was focused on the blast and paint operations. Since the completion of the FY-82 program, pre-installation work in the electrical craft area has been completed and is ready to proceed with installation in the FY-83 program.

II. DEVELOPMENT OF LABOR STANDARDS IN THE BLAST/PAINT BOOTH AREAS

A. PRIMARY OBJECTIVES

The primary objectives of the labor standards development phase were to:

1. improve facilities and equipment utilization
2. improve manpower use effectiveness
3. improve quantity of blasting and painting through identification of most appropriate equipment. and methods

B. METHODOLOGY

To insure the development of applicable labor standards for blast and paint booths, a combination of Planning observation, recordkeeping, and evaluation was required. Items listed below outline the steps involved in the process.

Establish linkage with interacting departments. A meeting was held with the department supervisors to explain the labor standards development program and request supervisors' cooperation and feedback. This meeting initiated background work to enable labor standards to be developed for the blast/paint booths.

Observe blast/paint booth utilization. The Industrial Engineer observed work going through the booths, noting: the types of work coming in, the arrival times for each type, and the related level of shop utilization. The objective was to determine shop capacity and to be able to project potential shop loading and scheduling procedures.

Record the work" methods. The methods were recorded to enable the observing analyst to review the process and its sequence.

Review the work methods. To insure the utilization of the best possible work methods , each recorded sequence was reviewed for completeness. At this point, methods were also analyzed for potential improvements.

Break down jobs into measurable elements. After the proper method was established, the jobs were broken down into smaller elements called sub-ops. For example: to blast a plate would be the job, but to prepare the operator to blast would be a portion/element of the job, or a sub-op. Sub-ops are combined to form a job or an operation.

Establish times for manual **approved** methods. Times were established per sub-op for the manual portions of each job. A predetermined time system (Most) was utilized.

Collect process/machine times. Time data for running of equipment (also called cycle time) had to be collected. These time elements are process controlled and were established using a stop watch.

Validate the process/machine times. Following review of process/machine times and completion of necessary equipment/operational. adjustments, times were once again validated against the originally established times . Once validated, accurate times were added to the labor standard.

° Determine job manning requirements. Throughout the establishment of the labor standards, manning

requirements were documented for each job in relation to number of personnel necessary to satisfactorily complete a job. The goal was to ensure that one person worked on a one-mn standard, two on a two-man standard, etc. thus reducing the practice of over manning.

Develop pick off sheets for estimating. Initial stage data gathering of manual and process times was recorded on individual sub-op charts (for example: prepare operator to blast). when these charts were combined, the sub-ops, when listed properly, would make up an operation. The times from these sub-op charts were combined to form pick off sheets. The combined times on the pick off sheets were called labor standards for a particular operation/job.

Develop labor standard. The raw times (manual and machine for completion of operations) were adjusted by adding both a personal, Fatigue and Delay Factor (PF&D) and a non-process factor. The PF&D factor represents a company wide percentage, and the non-process factor was derived from a work sampling (work sampling is a random observation technique which measures and analyzes work). The actual non-process factor represents the ratio of those random observations representing delays in elements of work to the total number of random observations.

⁰ Develop Work Management Manual(WMM). The final step in the development of labor standards was the assembly of all data into a Work Management Manual. The WMM was distributed to participating yards for transferability purposes, and covered topics ranging from yard policies and procedures to the actual labor standards. The sections of the WMM are:

- 1) Scope
- 2) Standard Practices and Policies
- 3) Facilities and Equipment
- 4) Layouts and Material. Flow
- 5) Process Data
- 6) Manual Methods
- 7) Standard Time Calculations
- 8) Data Synthesis and Back-up
- 9) Allowances
- 10) Standards Application

III. IMPROVEMENTS RESULTING FROM THE PROGRAM

Many improvements were initiated as a result of developing labor standards in the blast/paint booths. Seven of these improvements are described below.

A. SELECTION OF BLASTING GKIT TO OBTAIN A NEAR-WHITE SURFACE AND PROPER PROFILE FOR PAINTING

PBI had initially used a 50/50 mixture of #18 and #25

size steel grit to blast an intended 3 mil profile. In actuality, a 5 to 6 mil profile resulted, providing pockets too deep for the thickness of paint required on the plate. Excess paint must be used if the profile is too deep, and more time is required to paint the deeper profile. Since profile depth is relative to intended paint coverage desired, **changing to** a #40 size grit provided the desired 3 mil profile, saved paint, and cut wasted time.

B. INCREASED GRIT STORAGE AND PROVIDED MORE BLAST MORE BLASTING HOURS PER SHIFT

Prior to involvement in the program, only four of a possible eight hours could be utilized for blasting, the remaining four hours were spent cleaning up grit. The desired average of blasting time per shift was a minimum of six hours, and to address this problem, two changes were made.

- 1) Grit storage capacity was doubled by, adding hoppers (PBI doesn't have an automatic grit recovery system to return grit to the pressure hopper for re-use). The additional hoppers allowed more time to be spent blasting per eight hour shift.
- 2) A three (3) man crew was found to be more productive, using two (2) blasters and one (1) for grit clean up. The clean up operations could not keep pace with the blasting, but did allow

for the recycling and clean up of grit during the blasting process.

c. INSTALLATION OF A BLAST BOOTH VACUM RECOVERY SYSTEM TO IMPROVE PICK UP OF BLASTING GRIT FROM LIKE AREAS OF SHIP SECTIONS

The labor intensive method of grit recovery formerly in use required shovels, brooms and other hand recovery methods followed by a pressurized air blow down of surfaces. The new grit recovery system utilizes a vacuum and suction hose which can be moved into pocket areas to speed up grit and dirt clean up. The grit is returned to the blast unit after filtering for reuse.

D. UTILIZATION OF A SCOOPER AND POWER SWEEPER COMBINATION FOR FLOOR CLEAN UP

Use of the blasting booth for larger ship sections required a change from the former shovel and broom clean up of the blasting booth floor. The increased volume of steel grit proved too fatiguing to lift and required too much time for floor clean up. A Bob Cat front bucket loader is now used to scoop up the bulk of the grit and return it to the hopper and a power sweeper follows cleaning up the remaining grit. Clean up time was substantially reduced therefore, increasing the amount of work passing through the blast booth.

E. IMPROVED BLASTING OPERATOR' S CLOTHING FOR SAFETY

Several changes in the blasting operation necessitated an upgrade in protective clothing for the blast operator:

- 1) Use of steel grit rather than sand for blasting - when most blasting operations moved from outside into the blast booth, steel grit replaced sand as the blasting medium. Sand tends to break up on impact, into fine dust-like particles, and has little rebound. Steel grit, while it does break up somewhat, tends to bounce off the surfaces like pellets shot from a gun, and the usual protective clothing does not provide for adequate safety.
- 2) Use of a larger Venturi blast nozzle increased release of grit by almost 50 percent, compounding the effect of the steel as it impacted on the operator. The new clothing provided for the operator gives the needed protection from the grit and allows the operator to feel more at ease during the blasting operation.

F. PRODUCTIVITY INCREASED AND SAFETY FEATURES **FEATURES** ADDED

Three additional changes outlined below improved productivity 30 to 50 percent and also improved worker safety.

- 1) The change from a 7/16" to the 3/8" and 1/2" improved Venturi blast nozzles increased the flow of grit and therefore increased productivity.

- 2) Being able to cut off the grit as soon as the handle is released is an important safety feature. This feature was made possible with the installation of a dead-man hand switch on the nozzle. This switch would cut off the grit at the blast machine pressure tank rather than at the nozzle, eliminating the weight of grit that would have been in the line. This reduced weight allows the operator to re-position the hose more quickly with less fatigue (the grit hose can be more than 50 feet long and two to four inches in diameter - if loaded with grit it is extremely heavy to move).
- 3) Facilities were improved to provide the 100 PSI (up from 85 PSI) air pressure to the blast units needed to do an adequate job of blasting. Pressure was stabilized to provide constant production capacity, air dryers were installed to reduce moisture problems in the system and prevent grit caking, and airline filters were installed to prevent the system from plugging. These changes permitted smoother production.

IV. PROJECTS FOR IMPROVING PRODUCTIVITY

Two projects currently being considered will have a significant impact on increased productivity and reduced cost in the paint facility.

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A. LOOSE PARTS PAINTING FACILITY

The curing (drying) process for loose Parts will be speeded up by phacing parts into an oven immediately after painting. This process should enable the parts to move out of the facility five to six times faster than under the present process. The greatest improvement will be an increased curing time, which under nomalair drying could take up two days. This will substantially reduce the effect on the surface by dust and dirt, and improve paint surface quality.

B. PLURAL COMPONENT PROPOPTIONING SYSTEM

Use of a plural component proportioning system could improve productivity up to 35 percent by reducing the time required for mixing and handling of paint and cleanup. The airless spray system could also reduce paint usage up to 20 percent.

v. COMPUTER USAGE IN THE DEVELOPMENT OF LABOR STANDARDS IN THE BIAST/PAINT CRAFT AREAS

A. Use of cuter MOST was as follows:

1. loading data into the computer for storage and availability to all yards as transferable information
2. calculating standard times on sub-operations
3. reviewing methods (on a very limited basis)
4. producing the manual
5. estimating (minor use)

VI. APPRAISAL OF MEASURABLE BENEFITS IN THE BLAST/PAINT BOOTH AREAS

Productivity has increased dramatically in the Blast and Paint Shops as a direct result of this program. Usage of these shops prior to this study was limited and productivity data was nonexistent. For these reasons were unable to document precise gains .

VII. APPLICATION OF LABOR STANDARDS IN THE PIPE FABRICATION SHOP.

Actual application of the developed labor standards proceeded in three phases: the translation of pilot project techniques and procedures to everyday use, the revision of pick-off sheets and time reporting sheets, and the integration of the computer for pipe shop planning and operations recordkeeping.

A. BACKGROUND OF LABOR STANDARDS DEVELOPMENT IN THE PIPE FABRICATION SHOP

Labor standards for the Pipe Fabrication Shop were developed during Phase I of the SP-8 program. In September of 1981 a pilot program sponsored by MARAD through the SNAME Panel SP-8 was conducted at PBI. The purpose of this program was to determine:

- ° whether scheduling standards could be developed from MOST level times (plus a non-process factor to include real world considerations) resulting in realistic predictions of "will cost" charges for production work;
- ° whether scheduling standards could be applied efficiently for loading work in a shop; and if so

- whether mechanics could perform to the predictions of scheduling standards.

This pilot program established that:

scheduling standards could be developed that realistically predict production "will cost" charges; scheduling standards can facilitate shop loading; mechanics can perform to scheduling standard predictions; labor charges could be reduced by as much as two-thirds of previous expenditures for the same quantity of work.

B. INITIAL APPROACH TO THE APPLICATION OF LABOR STANDARDS INTO THE PIPE FABRICATING SHOP DURING THE FY-82 PROGRAM

PBI's Industrial Engineering Department had applied the labor (scheduling) standards to all work performed by the Pipe Fab Shop during the pilot program. The H.B. Maynard Labor Standard Classification Charts (appendix E) that were used as a basis for the application of the scheduling standards during this Pilot program were deemed to be inappropriate for everyday use in the Pipe Fab Shop for these reasons:

1. We did not fully understand how the data for the classification charts was combined. The charts were developed by the H.B. Maynard consultant using our developed data. The Industrial Engineering Department was not involved in the

procedure for developing these charts. It was difficult for our department to help the Production Control Department implement these charts when the back up data for the development of the charts was unknown.

2. It was decided that the use of the H.B. Maynard classification charts would be too time consuming in assigning the standards to the work orders.
3. The classification charts were not as accurate as we wanted. These charts were developed using averages and the number of occurrences as a basis . We felt that charts could be developed that would have unique values. Instead of averages, each operation had it's own value. with this idea in mind, charts were developed in the bending and fabrication areas with each operation having a specific time (appendices E-1, E-2, and E-3) . These charts, because they were developed jointly by the Industrial Engineering Dept. and Production Control, could be used to apply the standards to the Pipe Fab Shop on an everyday basis.
4. A need for an in-house shop planner developed as the result of the application of labor standards. The Industrial Engineering Department expected this need to develop, but Production Control was a little hesitant. When it was realized by Production Control the amount of time required to

affectively apply the standards and monitor the production feedback information, a permanent in-house shop planner was assigned to the Pipe Fab Shop to apply standards to the work orders, schedule work through the shop, and monitor the resulting production feedback.

During the Pipe Shop Pilot program a very useful tool developed by the Industrial Engineering Department that had an impact on the success of the program was an "Employee Timekeeping Chart" . (appendix D).

- a) This form was given to each employee in the Pipe Fabricating Shop to keep track of the amount of time spent on each detail. The form was broken down into fifteen minute increments for time reporting.
- b) The employee would list the work order number being worked on, the pipe detail being fabricated, the type of operation being performed at that time on the pipe detail (i. e., bending, sawing, inspection, etc.), and if he had a delay or was doing some sort of special work a column was provided for an explanation.
- c) The infomation reported back to the Industrial Engineering Dept. via these time sheets was used to compare the estimated times to the actual times.

- d) The explanation column proved to be helpful.
in the identification of some bottlenecks
that were taken care of during the Pilot
Program.
- e) The Pipe Fab Shop supervisors recognized
the fact that these time reporting sheets
could be used as a supplement to the
present time reporting system. The time
sheets, when used in conjunction with the
present job cards, would eliminate the
chances of mischarging.
- f) On this basis the supervisors decided to
adopt the idea of the time reporting form
and implement it into the fab shop as part
of their everyday operation procedure. A
few changes were made to the original idea
to break the information down into finer
bits of useful data.
- g) Appendix F is the present form used by the
entire Pipe Shop on a daily basis. As can
be seen, columns were added to reflect the
amount of rework time caused by human error
and the amount of "E" time (added time
caused by engineering changes such as
ECNS) . The employee will also check
whether the job is completed or partially
finished.
- h) At the present time these time sheets are
being used as a replacement for the job

cards. The information from these time sheets is fed directly to Payroll for the development of the employee's paycheck.

The extra work of filling out individual job cards was eliminated.

c. With the influx of a large number of ECNs (Engineering Change Notice) the labor standard originally applied to the work became obsolete. When comparing the estimated time to the actual time on the work orders that were affected by .ECNs, which was almost every work order on the first hull, there were sizable discrepancies. The reason for the discrepancies was the fact that the ECNs were not reflected in application of the original standard (the standards were applied long before the work was released onto the floor).

1. The ECNs that were released before work started were included in a revised estimate but the majority of ECNs came after the work was in the production process. - ECNs began coming down to the shop in large numbers causing the shop planner to fall further and further behind in **his** work. All the updating of original estimates was done manually by the shop planner. The help of the I.E. Department was requested.

2. The shop planner was being held accountable for any variance between the estimates and actual . times greater than 15%. This 15% variance was not common at PBI, but because of the use of

standards in the Pipe Fab Shop, the company decided to set-parameters to monitor the effectiveness of the standards.

a) The resulting reports were comparing estimated time to actual time plus rework time that was not include the original . estimate.

.b) The ECN problem actually planted the seed for the need of a computer to assist the shop planner. The computer will be discussed later in this report.

D. LABOR COST CONTROLS

One of the major goals to aim for when implementing a labor standards program such as the one in the Pipe Fab Shop is that of controlling labor costs. As PBI continued on with the standards program in the Pipe Fab Shop other possible controls could be seen on the horizon with just a little more thought and work.

1. For example, up to this point there was no set procedure for the control of piping details after they left. the Pipe Fab Shop.

a) The volme of work going out of the shop and into storage and then out of storage and into the boat resulted in "lost" fittings from completed details. The term lost could mean either that the parts were misplaced, or that they were used in

another system because those parts were missing.

- b) The shop developed a storage and tracking System to eliminate the problem. A procedure was set up to require a Uarco (appendix X) before any piece of pipe and/or fittings could be moved. The UARCO had to have such information as: where and by whom the piece(s) are moved, when the movement takes place, and who OK'd the move. Specific areas within the warehouses were identified and given a location number which appeared on the UARCO's for tracking purposes. The boats also had their own unique identification number to track the pieces after they leave the warehouses.
2. At the same time the tracking system was being developed, it was decided to refine the inspection procedure. The inspection operation was moved out of the Fab Shop and into the warehouses. When the details were moved from the Fab Shop to the warehouses, they were randomly inspected before storage. Moving the inspection people out of the Fab Shop opened more area for fabrication and other needed support services such as taping, capping, and identification of pieces. The details, when inspected, would be

entered into the books as inspected, stored, and ready for installation.

3. With the development of procedures for inspection, storage, and tracking of pipe details, a huge volume of paperwork and bookkeeping emerged. Five sets of books were kept by five different people in five different locations: Pipe Shop, planner, warehouse, inspection, and on the boat. Lack of centralized control caused disagreement in recordkeeping. This was a second argument for the implementation of a computer into the Pipe Fab Shop.
4. At this time, use of a computer to aid the shop planner was suggested. There was resistance by upper management because of lack of awareness of the amount of manual paperwork and bookkeeping that was required to have the control that the shop demanded.
 - a) The shop planner and shop supervisors with support from the I.E. Department, convinced PBI to set up a computer for the Pipe Fab Shop as a pilot program with the possibility of using similar programs in other shops.
 - b) During this planning stage to computerize the shop planning function, many side benefits were developed to aid the justification of the computer.. Some of

these side benefits were: handling of ECNs, monitoring the inspection of pipe details, tracking the details from the time of fabrication until installation in the boat, and the elimination and centralization of record keeping.

c) At this point the question was asked, "If the computer is going to be used for the above purposes, then why couldn't it also be used to assign standards?" With this in mind the shop planner and Industrial Engineering Department took the original standards pick-off sheets (appendices E-1, E-2, E-3) and adapted them for computer use. The computerized version of the standards pick-off sheets is called "Bending and Fabrication Chart Maintenance" screens (appendices J & K) 1 The charts were redesigned in a manner that did not affect their reliability or validity.

5. By using the Bending and Fabrication Chart Maintenance program, the shop planner can automatically assign standards per detail by calling out the type of material, the diameter, the number of joints, and/or the number of bends. A non-process factor is also added to the standard time automatically to make it realistic. With the implementation of the computer into the

Pipe Shop planning function, the record keeping, tracking, scheduling, and assigning of standards that formerly was done manually can now be done automatically with greater speed and accuracy.

- a) For example, with the capability of the computer to do the tracking function, four sets of hooks were eliminated along with bookkeeping tasks of four men.

- b) One person controls all information going into reports and they are updated on a daily basis.

6. This is not a case where computers eliminated workers, but it did release them for more productive tasks. In the past, supervisors were required to estimate the percentage of job completion. With the computer, this percentage is already calculated by dividing the actual time reported by the current estimate which has been established by labor standards :

- a) Because of the accuracy of the labor standards, the percentage of completion tends to be more accurate.

- b) with the information fed into the computer and the programing selected, the reports used in the past are easily accessed. An added benefit would be the opportunity to view the data frcm different angles to get an expanded picture of the shops production

status . An example of this expanded picture is the capability of the shop to know what is installed and what is ready for installation.

E. PRESENT COMMITMENT IN THE MARAD PROGRAM

The present commitment for PBI in the MARAD program is the application of labor standards into both the Paint/Blast Booths and the Electrical Shop. The labor standards for both areas are being designed for application by computer with programing similar to that of the Pipe Fab Shop. Along with the ease of labor standards application, the computer will also offer the element of control over costs. A sampling of sum programs being used in the Pipe Fab Shop are included in the appendix. An explanation of these programs will help in understanding how the computer is being used in the Pipe Fab Shop, as well as the control the shop has over its production costs. It should be noted that most figures in these screens are "dummy figures" that had to be entered in order to get the programs to print out as they would appear on the screen.

1. Appendix G: Work Order Detail Maintenance The shop planner uses this program to assign the standards to either a pipe detail sheet and/or an SIS sheet. An SIS sheet is a "Supplementary Instruction Sheet. " It shows only pipe that is bent on the Conrac bender. It is also later used

as a pipe detail sheet for fabrication. The planner will use the "Fab CD #" columns to assign fabrication standards. (The "Fab CD. #" means fab code which asks if it is a joint, flange, O-let, or cut, and indicates how many of each). At this point, the information from the pipe details is entered and, the planner will code the computer when all the pertinent data is complete. The computer will then go to the "Fabrication Chart Maintenance" program and assign the appropriate standards to the detail. The information entered for "mat'l type code", "pipe diameter" and "# of bends" will direct the computer to assign the bending standards from the "Bending Chart Maintenance" program. After assigning the standards for fabrication and/or bending, the computer will automatically assign non-process time. The rest of the screen is self-explanatory. Most of the other "report generating" programs are dependent upon this information being fed into the computer. This program is the driving force behind most of the other program.

2) Appendix H: Contract/Wl Display and Maintenance

This program gives the viewer a complete overview of the fabrication progress made by contract/hull. The screen has the scheduled start and finish dates for each hull. The first column is the fabrication

hours per hull and the second column relates to the bending hours per hull. The original estimated hours are, as indicated, the original estimate. The current estimated hours are the original estimate plus the added time generated by "pre-fabrication engineering changes." The "actual", "rework", and "E" hours are the hours charged to the work order as reported on the employees' time sheets (appendix F). Rework hours are added hours caused by human error and E hours are additions caused by "post-fabrication engineering changes."

- 3) Appendix I: Work Order Master Display and Maintenance. This program is a finer breakdown of the Contract/Hull Display and Maintenance (appendix H). With this program the planner can update the work order as a whole. Some options are changing the number of details involved, stop work and explain why, and list the work order as complete or partial without closing the work order. This screen is similar to appendix H because he/she could add (a), change (c), Or . reopen (R) the work order to Keep its status updated.
- 4) Appendix J: Bending Chart Maintenance The information is drawn from this program as directed by appendix G. Depending on what bender is used, Greenlee (G) or Conrac (C), will dictate which

bending chart will be utilized. - There are separate charts for the two benders. The Greenlee chart will have the possibility of added time for resin fill. This Possibility will be dictated by information added in the "Resin Fill (Y/N)" slot in appendix G. The standards which are dummy figures are in minutes and have the P, F&D time already figured in. This chart along with the next chart, "Fabrication Chart Maintenance, " was redesigned to be used in the computer. They are a condensed form of the charts that were used manually.

5) Appendix K: Fabrication Chart Maintenance

This program, as is the case with the Bending Chart Maintenance program, is directed by the Work Order Detail Maintenance program (appendix G). There are also two fabricating charts for bronze (B) and steel (S). Again these dummy times are in minutes with the P F & D time already included. As is the case with the bending chart, the standards are assigned strictly by frequency of occurrence (Example: If there were four 2" joints, the standard time would be 68 minutes without the non-process factor).

6) Appendix L: Work Order Detail Installation

When a pipe detail is put into the boat, those details are then listed as installed. This program gives the supervisor and planner a quick reference for checking what is installed. The date on which

the detail was installed is also listed. This program can be used as a quick check in the case of a fabricated pipe detail that can't be found. One possibility why the detail may not be found is that it may have already been installed. This program will answer that question. In the past, details were installed but not noted. When the details could not be found, instead of checking on the boat, new pieces were fabricated which resulted in duplication of work. This program eliminates that possibility.

7) Appendix M Work Order Detail UARCO Maintenance

This screen will give the viewer an update of all pipe details pertaining to a particular work order. When viewing this screen the supervisor or planner can tell if the detail is bent and/or fabricated; if they are inspected; if installed; location of detail, whether they are still in the warehouse or on the boat; which UARCO's were used to move the details; and the last date that the detail was updated. Along with the above information, special information that may affect the detail is also listed. In other words, this screen presents the updated, overall production status of each detail.

8) Appendix N: Work Order Detail ECN Update The

detail update screen is used by the planner to continually keep pace with the influx of ENCS into the production process. The screen will list the

latest ECN affecting a particular detail. The "New ECN" column is where any newly issued ECN is tied into the affected pipe detail.. The screen can also be used as a quick reference to a particular ECN to be reviewed.

- 9) Appendix o: Contract Schedules By listing a particular work order, the planner can review the scheduling for that work order for the complete contract. Many of the piping systems are broken down by phases, which are dictated by modular construction. The program will list by work order, the start and finish bend dates, along with the Start and finish fabrication dates. The planner uses this tool to schedule his work through the shop .
- 10) Appendix Q: Daily Work Sheet Entry This program will be used to replace the present job cards. The information for this program is picked off the employee's daily worksheet (appendix F). From this information the supervisor or planner will be able to see what details were worked on by whom, and when. The amount of time per detail is also listed on the employee's worksheet. This can be used by the Industrial Engineering Department to check the actual time against the reported time. This entry will show an explanation by the employee for "E" and "R" work. "R" being rework caused by human error and "E" used to indicate rework caused by

engineering changes. If there are more than 480 minutes reported on an employee's worksheet, and the employee was scheduled for eight hours of work, the computer will not accept that number unless the planner overrides the figure. This is a security feature built into the computer to eliminate the element of human error. The reports generated by the Daily work Sheet Entry will then be sent up to Payroll to develop the paychecks. This eliminates the step of filling out job cards and sending them to Payroll. Also, on the employee's worksheet, he/she will indicate whether the detail is completed or partially completed.

- 11) 4pendix R: Work Order Detail Display This display screen will pull together all information entered in the other programs pertaining to a certain detail from a particular work order. The contents of this screen are self explanatory. If the planner or supervisor wishes to Know all the updated information and status of a particular detail, this is the screen he/she would call upon.
- 12) Appendix s: Work Order Status Display As the title states, this screen displays the current status of each detail from a particular work order. The information appearing on the screen will inform the viewer if the SIS sheet is bent and inspected, and if the pipe detail is fabricated and inspected and if the detail or SIS is jnstalled.

It would also show any special information that would affect the detail or SIS sheet, the present location of the piece, the UARCO that moved the piece to its present location and the date it was stored. This screen is used in the tracking of pipe details after they leave the Pipe Fabrication Shop. This is a valuable tool when an ECN or other me of revision is released affecting a fabricated pipe detail.

- 13) Appendix T: Work Order Details Ready for Installation This program is very useful for the supervisors in the installation area of the Piping Department. When a detail is ready for installation, the computer will automatically transfer the pertinent information pertaining to a particular detail over to this program to aid the installation supervisors in scheduling their work. It also tells the supervisor where these details can be found.
- 14) Appendix U: Work Order Delays This screen is very simple and will list all work orders that are delayed. when the planner is asked the status of a certain work order, this is one tool he/she could use to make sure it isn' t delayed. If the work order does show up on the screen, this will indicate to the planner to check further to see what is causing the delay.

15) Appendix W: Work Order UARCO History The UARCO History program will keep track of all UARCO's, and what details they may have affected. With this program the details can be tracked by UARCD's. A UARCO is needed whenever an item is to be requested or moved. For example, in appendix W detail BBE was moved to the Stone Basement on 9/26/83 on UARCO 999999. On 10/11/83 the same detail was moved back to the Pipe Fab Shop for rework on UARCO 319419. @ 10/13/83 the detail was moved back to the Stone Basement for storage on UARCO 207674. W 11/8/83 two pieces of BBE were moved out to the boat using UARCO 319790. This is an example of how details **can** be tracked by UARCO.

16) Appendix Y: Work Order ECN History The ECN History program will list all ECNs affecting a work order. The listing will also show what details from the work order are affected by which ECNS. Sometimes one ECN will affect more than one detail. **The** history will also inform the viewer when the ECN'S weree issued. Being the ECNs are engineering changes, the program will also list the amount of "E" time that is generated through the ECNs in both bending and fabrication.

F. CONCLUSION

This concludes an insight into a few of the planning programs and the reports generated as a result of the

entered data. With the addition of these programs into the pipe planning process, the job of the planner has not only been streamlined, but it has also added the benefit of accuracy to his everyday task. The Pipe Shop planner. is currently developing a program to sell this concept to other shops. The program stresses the benefits and advantages to both the Pipe Fabricating Shop and PBI as well as the importance of labor standards as a foundation upon which efficient, quality production is built. Since the start" of the MARAD project in the Pipe Fab Shop there have been significant cost reductions. as mentioned at the beginning of the report, the entire original piping procedure had to be evaluated. Many drastic changes had to be made in the production procedures, such as separating the pipe fabrication from the pipe installation . With the change in fabrication and installation areas along with the application of labor standards in the Pipe Fab Shop, there was a reduction in the number of fabrication employees required to support the installation people. When the development of labor standards began, there were approximately 50 fabricators supporting the installation. Presently the tier of fabricators has been reduced to 17, not including some of the support services such as dipping, inspection and warehousing personnel. The installation area is still about the same as when there were 50 fabricators. The cost reduction in fabrication

amounted to \$686,400.00. When the computer was added to the pipe fabrication planning procedure, one of the measured benefits was the elimination of time consuming bookkeeping. The books had to be kept manually to control the newly installed tracking system. When the computer was implemented, the bookkeeping task was more accurate and could be centrally controlled by one person. With the elimination of four sets of books, two man years could be assigned to more productive tasks. This amounted to a bookkeeping cost reduction of \$40,800.00. The procedure for getting the two man year figure is from the fact that four men were keeping the same books in different locations. They spent approximately half their time keeping these books updated. The combination of the two cost reductions amount to a total cost reduction of \$727,200.00. There also has been immeasurable cost reductions that have resulted from the impletation of labor standards and other uses of the computer in the Pipe Fab Shop. By continuing with the application of labor standards in the Electrical Shop and Blast/Paint Booth areas, cost reductions will no doubt continue.

APPENDIX A

LABOR STANDARD PROCESS SHEETS

The following labor standards process sheets and source data sheets are all the required forms needed to. apply labor standards to work performed in the electrical craft area.

The electrical work has been classified into three categories. These categories distinguish the operations performed: .

(1) On Cable

These forms consist of:

- (a) cable labor standards process sheet
- (b) source data sheet pick off charts for tags,
cutting , pulling and banding cable .
- (c) cable pull form

(2) on Equipment

These forms consist of:

- (a) equipment labor standard process sheet
- (b) cable hookup pickoff sheet
- (c) standard electrical symbol list.

APPENDIX A (CONT'D)

(3) For Miscellaneous Work

The form consists of:

- (a) miscellaneous labor standard process sheet.

Each labor standard process sheet utilizes the-pick off type of charts which has number of advantages for this we of approach to establish labor standards.

- (1) The process of applying the standard is simple and the forms easy to work with, requiring instruction to use for a person familiar with the work.
- (2) No judgment decisions are required as the selection of the standard is based on identifying sizes, types, number of items, etc. " describing the part or work.
- (3) The standards should be consistent as the chances of error will be minimal using the same type of procedure to apply a standard.
- (4) The standard takes little time to apply.
- (5) A review of the standards at any tim can be made quickly as the forms and procedures are easy to work with.
- (6) me accuracy of the standard once validated would apply to all standards established frcm these forms.

ELECTRIC DEPT. _____

ITEM DESCRIPTION _____

JOB DESCRIPTION _____

*THESE TIMES INCLUDES 25% SHIP INTERFERENCE TIME

[illegible]

WORK ORDER #

WORK ORDER #

WORK ORDER #

WORK ORDER #

WORK ORDER #

TAG PICKOFF CHART

# OF TAGS RATE MAKEUP INSTALL			# OF TAGS RATE MAKEUP INSTALL			# OF TAGS RATE MAKEUP INSTALL		
1	.03	.027	16	.51	.43	31	.99	1.83
2	.06	.05	17	.54	.45	32	1.02	.86
3	.09	.08	18	.57	.48	33	1.05	.89
4	.12	.10	19	.60	.51	34	1.08	.91
5	.16	.13	20	.64	.54	35	1.12	.94
6	.19	.16	21	.67	.56	36	1.15	.97
7	.22	.18	22	.70	.59	37	1.18	.99
8	.25	.21	23	.73	.62	38	1.21	1.02
9	.28	.24	24	.76	.64	39	1.24	1.05
10	.32	.27	25	.80	.67	40	1.28	1.08
11	.35	.29	26	.83	.70	41	1.31	1.10
12	.38	.32	27	.86	.72	42	1.34	1.13
13	.41	.35	28	.89	.75	43	1.37	1.16
14	.44	.37	29	.92	.78	44	1.40	1.18
15	.48	.40	30	.96	.81	45	1.44	1.21

SETUP TIMES

MAKING TAGS (.278 HR)
INSTALLING (.482 HR)

PICKOFF CHART FOR CUTTING AND PULLING CABLES
SETUP TIMES
CUTTING (.103 HRS)
PULLING (.118 * # OF WORKERS)

RATE LENGTH CUTTING PULLING			RATE LENGTH CUTTING PULLING			RATE LENGTH CUTTING PULLING		
TO 3/4 >	TO 3/4 >		TO 3/4 >	TO 3/4 >		TO 3/4 >	TO 3/4 >	
10	.11	.13	160	.28	.61	310	.44	1.09
20	.12	.17	170	.29	.65	320	.45	1.13
30	.13	.20	180	.30	.70	330	.46	1.16
40	.14	.23	190	.31	.74	340	.47	1.19
50	.16	.26	200	.32	.78	350	.48	1.22
60	.17	.29	210	.33	.81			
70	.18	.33	220	.34	.84			
80	.19	.36	230	.35	.87			
90	.20	.39	240	.36	.90			
100	.21	.42	250	.37	.93			
110	.22	.45	260	.38	.96			
120	.23	.49	270	.40	.99			
130	.24	.52	280	.41	1.00			
140	.25	.55	290	.42	1.03			
150	.26	.58	300	.43	1.06			

PICKOFF CHART FOR BANDING CABLE SETUP TIME (.55 HRS)			# OF BANDS RATE			# OF BANDS RATE		
10	1	110	5	210	10	310	14	1
20	1	120	5	220	10	320	15	2
30	1	130	6	230	10	330	15	3
40	2	140	6	240	11	340	15	4
50	2	150	7	250	11	350	16	5
60	3	160	7	260	12	360	16	6
70	3	170	8	270	12	370	17	7
80	4	180	8	280	13	380	17	8
90	4	190	9	290	13	390	18	9
100	5	200	9	300	14	400	18	10

CABLE LABOR STANDARD PROCESS. SHEET -
SOURCE DATA

APPENDIX A-3
CABLE PULL NO. 1 (Cont.)

CABLE NO.	DWG. NO.	NO. OF TAGS	TYPE-SIZE	LENGTH	REEL NO.	REMARKS
(11P)-4P-C(1) (1691)-4P-C(1)	320-055	10	TSGU - 4	✓ 195	3034	MARK 5
K-TW193	320-073	12	DSGU - 4	✓ 161	2981	
K-TW194	"	12	DSGU - 4	✓ 161	2981	
K-TW195	"	12	DSGU - 4	✓ 161	2981	
K-TW196	"	12	DSGU - 4	✓ 161	2981	
K-TW220	"	12	TSGU - 4	✓ 146	3034	
K-TW189	"	12	FSGU - 4	✓ 148	3013	
K-TW190	"	12	FSGU - 4	✓ 148	3013	
K-TW191	"	12	FSGU - 4	✓ 148	3053	
K-TW192	"	12	FSGU - 4	✓ 148	3053	
K-TW212	"	12	7SGU - 4	✓ 159	3031	
K-TW213	"	12	7SGU - 4	✓ 159	3031	
K-TW214	"	12	7SGU - 4	✓ 159	3031	
K-TW215	"	12	7SGU - 4	✓ 159	3031	
K-TW216	"	12	7SGU - 4	✓ 159	3031	
K-TW217	"	12	7SGU - 4	✓ 159	3031	
K-TW218	"	12	7SGU - 4	✓ 159	3031	
K-TW219	"	12	7SGU - 4	✓ 159	3031	

PBI DWG. #
SYN

EQUIPMENT LABOR

STANDARD PROCESS SHEET

ELECTRIC DEPT. _____

LOCATION _____

ITEM DESCRIPTION _____

JOB DESCRIPTION _____

PICK OFF CHARTS-ALL TIMES IN STANDARD
(INCLUDES 15% PFD)

*THESE TIMES INCLUDES 25% SHIP INTERFERENCE TIME

SET-UP
.59* CABLE HOOKUP
TERMINATION

TYPE TIME QTY. TOTAL

SET-UP
.38

EQUIPMENT PREP.

1 .35 2 .45

3 .60 4 .70

5 .80 6 .95

7 1.05 8 1.2

9 1.3 10 1.4

11 1.55 12 1.65

SET-UP
.59

* MOUNTING EQUIP.

EQUIP. CODE
SIZE _____TIME FROM
SYMBOL BOOK

* TES

QTY. TOTAL

TOTAL HRS.

TOTAL HRS.

TOTAL HRS.

TOTAL H

WORK ORDER #

WORK ORDER #

WORK ORDER #

WORK ORI

CABLE HOOKUP PICKOFF SHEET

CODE SIZE	SIZE ENCLOSURE				SIZE ENCLOSURE		
	SMALL	MEDIUM	LARGE		SMALL	MEDIUM	LARGE
CABLE TYPE							
DNW-3 THRU 23	.24	.82	1.54	3SWU	1.02	1.87	3.06
TNW-3 THRU 23	.33	1.12	2.11	3SWU-7	2.28	4.17	6.84
FNW-3 THRU 23	.41	1.29	2.62	3SWU-10	3.22	5.89	9.66
MNW-7	.71	2.41	4.54	3SWU-14	4.47	8.18	13.41
MNW-10	.98	3.33	6.27	3SWU-19	6.00	10.98	18.00
MNW-14	1.33	4.52	8.51	3SWU-24	7.60	13.91	22.80
MNW-19	1.78	6.05	11.39				
MNW-24	2.22	7.55	14.21	2SWU-3	.54	1.68	1.94
MNW-30	2.76	9.38	17.66	2SWU-7	1.64	3.28	5.90
MNW-37	3.38	11.49	21.63	2SWU-10	2.21	4.42	7.06
MNW-44	4.00	13.06	25.60	2SWU-14	3.21	6.42	11.56
MNW-50 THRU 150	.33 ALL SIZES			23WU-19	4.32	8.64	15.55
TNW-50 THRU 150	.49 ALL SIZES			2SWU-24	5.44	10.88	19.58
				2SWU-30	6.78	13.56	24.41
DSGU-3 THRU 23	.22	1.22	2.68				
TSGU-3 THRU 23	.28	1.56	3.41	3SU-3	.88	1.58	4.45
FSGU-3 THRU 23	.34	1.89	4.14	3SU-7	1.97	3.55	5.52
7SGU-3&4	.51	2.84	6.21	3SU-10	2.77	4.99	7.76
6SGU-100 THRU 200	.83 ALL SIZES			3SU-14	3.85	6.93	10.78
				3SU-19	5.19	9.34	14.53
1SWU-2	.28	.51	.84	3SU-24	6.33	11.75	18.28
1SWU-14	.94	1.72	2.82	3SU-30	7.90	14.22	22.12
1SWU-20	1.27	2.32	3.81				
				TTSU&TTNW-1 1/2	.33	1.22	2.31
2SWU & 2WSU-7	1.89	3.46	5.67	TTSU&TTNW-3	.57	2.11	3.99
2SWAU-10	2.67	5.34	9.08	TTSU&TTNW-5	.88	3.26	6.16
2SWAU-12	3.19	5.80	9.57	TTSU&TTNW-10	1.71	6.33	11.97
2SWAU-14	3.17			TTSU&TTNW-15	2.52	9.32	17.64
2SWU & 2SWAU-19	5.00	9.15	15.00	TTSU&TTNW-30	3.32	12.28	23.24
2SWU & 2SWAU-24	6.30	11.53	18.40				
2SWU & 2SWAU-37	9.67	19.43	32.88				

EQUIPMENT LABOR STANDARD PROCESS SHEET - SOURCE DATA

STANDARD ELECTRICAL

SYMBOL LIST

SIZE	STD	SYM. NO.	ITEM	STD DWG & SPEC	STOCK NO.	WT
		713(100)	Cable assembly, 125V, 10A, SBM-4000, 3 Cond., TSS-4 cable, 100 ft length	MIL-C-24231/1	9G6150-00-681-8380	*
		713.1	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (7 Cond.)	MIL-C-24231/3	1H5935-00-706-9360	16.0
		713.1(90)	Cable Assembly, 125V-10A, SBM-4000 (7 Cond.) FSS-2 Cable	MIL-C-24231/3-001	1H5995-00-070-9489	13.5
		713.1(100)	Cable Assembly, 125V-10A, SBM-4000 (7 Cond.) 2 SW-3 Cable	MIL-C-24231/3-001	1H5995-00-070-9512	*
		713.2.	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (14 Cond.)	MIL-C-24231/4-001	1H5935-00-705-1665	*
		713.3	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (24 Cond.)	MIL-C-24231/4-002	1H5935-00-064-2036	*
		713.4	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (30 Cond.)	MIL-C-24231/4-003	1H5935-00-064-2038	*
		713.5	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (3 Cond.) (90°)	MIL-C-24231/2-001		
		713.6	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (4 Cond.)	MIL-C-24231/1-002		*
		713.7	Molded Plug Kit, 300V-6A, 125V-10A, SBM-400 (9 Cond.)	MIL-C-24231/3-002	1H5935-00-064-2017	*
		713.8	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (4 cond.) (90°)	MIL-C-24231/2-002		*
		713.9	Molded Plug Kit, 300V-6A, 125V-10A, SBM-4000 (3#12 Cond.)	MIL-C-24231/23-001		*
		713.10	Molded Plug, 300V-6A, 125V-10A, SBM-4000, (40 Cond.)	MIL-C-24231/4-003		*
		713.11	Epoxy splice kit, for DSS-3 cable	803-1197255	1H5995-00-657-6313	*
		714	Obsolete		5.5	
		715	Superseded by Sym. No. 715.1	S6202-73882		
		715.1	Plug, DP - 40A-125V DC Male	MIL-R-2726/1	9H5935-00-170-3061	0.5
		716	Superseded by Sym. No. 716.1	S6202-73882		
		716.1	Plug, 30 - 50A-250V-DC - male	MIL-R-2726/2	1H5935-00-852-4199	0.5
		717	Superseded by Sym. No. 717.1	S6202-73882		
		717.1	Plug, 4P-40A-450V AC Male	MIL-R-2726/3	9H5935-00-935-2235	0.5
		718	Superseded by Sym. No. 718.1	S6202-73882		
		718.1	Plug, 12P-5A-125V DC	MIL-R-2726/4		0.5
		720	Superseded by Sym. No. 720.3	MS17791		
		720.1	Superseded by Sym. No. 720.3	MS17791		
		720.2	Superseded by Sym. No. 720.3	MS17791		

FBI DWG. # _____

MISC. LABOR

TANDARD PROCESS SHEET

ELECTRIC DEPT. _____

LOCATION _____

ITEM DESCRIPTION _____

JOB DESCRIPTION _____

PICK OFF CHARTS-ALL TIMES IN STANDARD HOURS
(INCLUDES 15% PFD)

*THESE TIMES INCLUDES 25% SHIP INTERFERENCE TIME

SET-UP .44 HRS

SET-UP .75 HRS

*PACKING MCT	*SHOOTING STUDS
MCT # _____	COMPARTMENT _____
LOCATION _____	DWG # _____
# OF CABLES _____	# OF STUDS _____
SIZE OF MCT _____	
TIME/MCT .120 HRS	TIME/STUD .05 HRS
TIME/CABLE .065 HRS	
TIME/BLANK .023 HRS	
TOTAL HRS. _____	TOTAL HRS. _____
WORK ORDER # _____	WORK ORDER # _____

APPENDIX B

BLAST & PAINT PICKOFF CHARTS

The Blast and Paint Pickoff **Charts** are set up by the area of a piece in square feet. The paint chart is broken down into two categories; flat surface and irregular surface. Irregular surfaces would include stiffeners and any other irregular shapes welded to the surface. The blast chart is broken down into categories also; sweep blast and full blast. "Sweep blast" is a type of blast used when two pieces are welded together and the shop primer was burned or ground off in the area of the weld and small rust spots are developing in these areas. The sweep blast is used to put a profile into these areas for paint to adhere to. "Full blast" would be used on heavily rusted areas.

The times on these charts include the process times and manual times for blasting and painting. They do not include set-up and tear down of operator or equipment, get and mix the paint, load grit in blasters, or cleanup.

There are separate charts for painting of small parts, and set-up and tear down for blasting and painting. The set-up and tear down times must be added to the blast, paint, and small parts painting chart times. These operations may occur only a fraction of the time or a number of times per job depending on the job content.

APPENDIX B (CCNT'D)

The pickoff chart for painting" small parts is based on the area of a 4' X 8' table that the part would cover when it is loaded on the table. The full blast category will be used for blasting of small parts.

APPENDIX B-1

BLAST AND PAINT PICKOFF CHART

AREA IN SQ FT	PAINTING TIME IN HOURS		BLASTING TIME IN HOURS	
	FLAT SURFACES	IRREGULAR SURFACES	SWEEP BLAST	FULL BLAST
0-100	.066	.089	.167	.298
100-200	.132	.179	.333	.597
201-300	.198	.267	.5	.895
301-400	.264	.356	.667	1.20
401-500	.329	.444	.833	1.49
501-600	.395	.533	1.0	1.79
601-700	.460	.621	1.17	2.09
701-800	.526	.710	1.33	2.39
801-900	.591	.798	1.5	2.69
901-1000	.656	.886	1.67	2.99
1001-1100	.721	.974	1.83	3.29
1101-1200	.787	1.07	2.0	3.58
1201-1300	.854	1.16	2.17	3.88
1301-1400	.920	1.24	2.33	4.13
1401-1500	.986	1.33	2.5	4.48
1501-1600	1.050	1.42	2.67	4.78
1601-1700	1.12	1.51	2.83	5.07
1701-1800	1.19	1.60	3.0	5.38
1801-1900	1.25	1.69	3.17	5.67
1901-2000	1.32	1.78	3.33	5.97
2001-3000	1.39	1.87	3.5	6.27
2101-2200	1.45	1.96	3.67	6.58
2201-2300	1.52	2.05	3.83	6.89
2301-2400	1.59	2.14	4.0	7.20
2401-2500	1.65	2.23	4.17	7.51
2501-2600	1.72	2.32	4.33	7.82
2601-2700	1.79	2.41	4.5	8.13
2701-2800	1.85	2.50	4.67	8.44

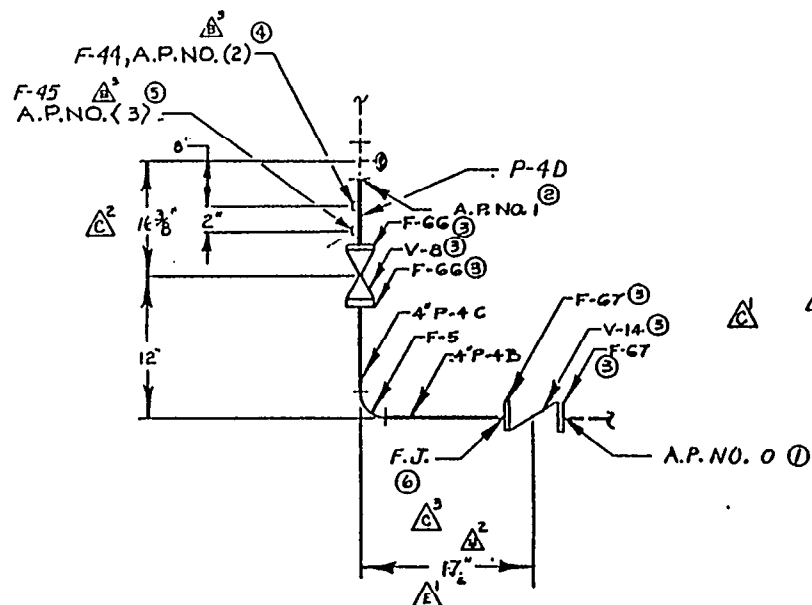
APPENDIX B-2

BLAST AND PAINT PICKOFF CHART

PAINTING OF SMALL PARTS

AREA OF PART IN SQ FT	.25	.5	.75	1	1.5	2	2.5	3	.3.5	4	6	8
HOURS	.007	.008	.009	.011	.013	.015	.016	.017	.018	.019	.026	.029

<u>SET.-UP FOR PAINTING (IN HOURS)</u>					<u>SET-UP FOR BLASTING (IN HOURS)</u>				
NO. OF OCCURRENCES	1	2	3	4	NO. OF OCCURRENCES	1	2	3	4
SET-UP & TEARDOWN	.062	.124	.185	.300	SET-UP & TEARDOWN	.096	.192	.282	.383
TRANSPORT POINT	.075	.15	.225	.300	CLEANUP	.797	1.59	2.39	3.19
SET-UP & TEAR DOWN EQUIP	.38	.761	1.41	.52	PARTIAL CLEANUP	.10	.20	.30	.40



1. A.P. NO. (0) IS CONN. TO A.P. NO. (1) ON SPOOL NO. 9433-524-CBM.
2. A.P. NO. (1) IS CONN. TO A.P. NO. (0) ON SPOOL NO. 9433-524-CBM.
3. V-8, V-14, F-67/F-66 ARE TO BE KEPT LOOSE FROM ASSM.
4. A.P. NO. (2) IS CONN. TO THERMOMETER
5. A.P. NO. (3) IS CONN. TO INSTRUMENTATION LINE.
6. P-4B HAS A FIELD JOINT AT THIS POINT.

PC NO	QTY	DESCRIPTION
F-44	1	3/4" WELDED BASE + SIL-B. END BOSS 7/8" CU-III
F-45	1	1/4" WELDED BASE + SIL-B. END BOSS 3/4" CU-III
F-4D	9	1/8" 1/2" 1/2" 1/2" 1/2" 1/2" 1/2" 1/2" 1/2"
P-4C	5	1/2" 1/2" 1/2" 1/2" 1/2"
P-4B	13	1/2" IPS TUBE 20-10 CU-NI.
F-5	1	90° ELL.
F-66	2	150"
F-67	2	FLG. 250" SIL-B
V-8	1	GATE V. 100"
V-14	1	4" SWING CHK. V 250" FLG 2RZ.

SPOOL NO. 9433-524-CBN-REV. E
 DRWG NO. 9433-524-056-REV. G

Appendix D

DATE:

TIME KEEPING CHART (Pipe Shop Pilot Program)

	WORK ORDER #	DETAIL DRAWING #	TYPE OF OPERATION *	REASON **
6:45				
7:00				
7:15				
7:30				
7:45				
8:00				
8:15				
8:30				
8:45				
9:00				
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2:00				
2:15				
2:30				
2:45				
3:00				
3:15				
3:30				
3:45				
4:00				
4:15				

- *TYPE OF OPERATION:
1. Sawing
 2. Benchwork
 3. Delays
 4. Bending
 5. Inspection
 6. Special Work

**Use this column only when type of operation number is 3 or 6.

**FABRICATION ESTIMATING STANDARDS IN DECIMAL HOURS
EXCLUDING BENDING**

Add for:

1 Hole Drilled: .16

Black Steel Pipe

4" Diam.

1 End Threaded

PIECES OF PIPE	NUMBER OF JOINTS BRAZED/FIT & TACK																	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	.32	.50		.72		.98												
2	.72		.98			1.3												
3	.98	1.3				1.6												
4	1.6				2.0				2.4									
5						2.4												
6	2.4					2.9												
7									3.4									
8												3.9						
9														4.5				
10																5.1		

P.B.I. W.O. NO.

CARBON STEEL FITTINGS

HOURS

P.B.I. DWG. NO.

SHEET NO. -

DATE

SIZE	1 JOINT	2 JOINTS	3 JOINTS	4 JOINTS	FLANGES	SLEEVE VALVES	"O" LETS BOSSSES	BOLT FLANGE	SCRD FITTINGS
1/2"	12x	20x	28x	37x	23x	36x	31x	20x	16x
3/4"	12x	21x	30x	41x	26x	38x	32x	20x	16x
1"	15x	23x	31x	43x	27x	42x	34x	20x	16x
1 1/4"	19x	37x	59x	80x	29x	43x	36x	20x	16x
1 1/2"	20x	39x	61x	81x	30x	43x	37x	20x	16x
2"	21x	40x	62x	84x	32x	44x	38x	30x	16x
2 1/2"	23x	41x	66x	89x	33x	45x	39x	30x	18x
3"	24x	44x	71x	94x	34x	46x	40x	30x	18x
3 1/2"	25x	46x	72x	95x	35x	49x	42x	30x	18x
4"	37x	78x	105x	143x	53x	83x	69x	40x	30x
5"	43x	82x	125x	166x	55x	87x	72x	40x	30x
6"	46x	88x	130x	173x	58x	90x	73x	40x	30x
8"	48x	93x	137x	184x	63x	91x	75x	40x	

P.H.E. W.O. #		SIL-BRAZE FITTINGS						HOURS	
P.B.I. DIR. #		SHEETS #						DATE	
SIZE	1 JOINT	2 JOINTS	3 JOINTS	4 JOINTS	FLANGES	SLEEVE VALVES	"O" FITS BOSSSES	WELT FLANGE	SCUD FITTINGS
1/2"	8x	15x	23x	31x	31x	23x	23x	21x	14x
3/4"	11x	19x	28x	38x	38x	26x	25x	21x	14x
1"	12x	21x	30x	43x	39x	27x	26x	21x	14x
1 1/4"	14x	25x	34x	47x	41x	28x	27x	21x	14x
1 1/2"	17x	28x	39x	53x	46x	31x	29x	21x	14x
2"	18x	34x	46x	60x	53x	37x	32x	32x	14x
2 1/2"	21x	35x	48x	62x	54x	38x	36x	32x	16x
3"	22x	37x	51x	67x	57x	40x	37x	32x	16x
3 1/2"	23x	38x	52x	68x	64x	41x	38x	32x	16x
4"	50x	82x	119x	154x	137x	103x	80x	41x	28x
5"	52x	87x	123x	161x	145x	105x	82x	41x	28x
6"	67x	113x	158x	205x	188x	133x	97x	41x	28x
8"	107x	176x	246x	311x	277x	205x	137x	41x	

REVISED PICK-OFF SHEET

P.O.I. W.O. |

STAINLESS STEEL FITTINGS

PAGE:

P.O.I. DIM. |

SHEETS |

-

DATE:

SIZE	1 JOINT	2 JOINTS	3 JOINTS	4 JOINTS	FLANGES	SLAVE VALVES	"O" LERS BOSSES	BOLT FLANGE	SCW FITTINGS
1/2"	13x	22x	31x	41x	23x	42x	35x	21x	18x
3/4"	15x	23x	34x	45x	26x	46x	37x	21x	18x
1"	17x	28x	38x	52x	27x	49x	38x	21x	18x
1 1/4"	23x	46x	72x	94x	29x	53x	39x	21x	18x
1 1/2"	26x	49x	76x	99x	30x	54x	41x	21x	18x
2"	27x	52x	77x	103x	32x	57x	42x	32x	18x
2 1/2"	28x	53x	82x	108x	33x	61x	43x	37x	20x
3"	30x	57x	85x	114x	34x	62x	45x	32x	20x
3 1/2"	33x	60x	88x	115x	36x	65x	46x	37x	20x
4"	49x	92x	122x	175x	48x	97x	79x	41x	31x
5"	57x	103x	149x	199x	53x	110x	81x	41x	31x
6"	60x	107x	154x	205x	56x	112x	82x	41x	31x
8"	68x	118x	172x	229x	62x	122x	88x	41x	

REVISED PICK-OFF SHEET

REVISÉD TIME SHEET

FABRICATOR DAILY WORK SHEET

DATE: _____

NAME: _____

EMP. # _____

[illegible]

DIPO005/PIPS000 WORK ORDER DETAIL MAINTENANCE 1/06/84 12:44:05
 CONT HULL ASSY W.O. NO. DTL SIS ITEM#
 9950 0051 0104 255 214 BAA

 ACTION--> (A=ADD C=CHG D=DEL R=REV) STATUS... A REJECT DATE...
 HULL TO UPDATE-->
 DTL REVISION LTR--> F ENG CHG NOTICE-->
 SIS REVISION LTR--> PHASE-----> 1
 SPECIAL INFO-----> RATE LTR----->
 DATE RECD-----> RELEASE DATE----->
 RATE ORDER DATE--> EAP COMPLETE-----> Y
 INSTALLED (Y/N)--> Y DAPC1 DAPC2-----> 319743
 LOCATION/PALLET--> AT A122BA GALVANIZED (Y/N)-->
 RATE TYPE CODE--> PIPE DIA (IN)-->
 PIPE LENGTH FT--> 1.0005-2 # OF BENDS----->
 * SPECIAL BENDS--> 1 RESIST FILE (Y/N)--> Y
 SCHOOL TAG DATE--> 101733 SCHOOL BIRTH DATE--> 101083
 TAG LENGTH IN-----> 255 BEND COUNT--> 517 ADJ THICK-->
 STOP WORK DATE--> STOP WORK PLG-->
 EAP CD # EAP CD # EAP CD # EAP CD # EAP CD # EAP CD #

CMD FERR FORK CMD FERR AC CMD A2 B2D 01111 CMD SE 1/0 STATUS CMD 0201 05

Information is entered on this screen and will generate most of the following reports.

PIPD03/PIPS003

CONTRACT/HULL DISPLAY & MAINT

1/06/84 12:32:25

CONTRACT-> 9550 HULL-> 0051
 SAME AS CONTRACT-> HULL->

ACTION-> C (A=ADD C=CHANGE D=DELETE)

SCHEDULED START DATE-> 120682

SCHEDULE FINISH DATE-> 032384

* OF WORK ORDERS... 235

WORK ORDERS COMPLETE... 0

ORIG EST HRS FARE... 8821.50

ORIG EST HRS FARE... 1739.81

CURR EST HRS FARE... 8003.45

CURR EST HRS FARE... 1733.55

ACTUAL HOURS FARE... 792.75

ACTUAL HOURS FARE... 143.01

REWORK HOURS FARE... 71.75

REWORK HOURS FARE... 10.00

TOTAL HOURS FARE... 234.75

TOTAL HOURS FARE... 20.02

DATE OF CLOSE.....

CANDIDATE FOR CANCELLATION OF CONTRACT

Overall view of status of a parti-
 contract/hull.
 Information is gathered from screen
 this appendix.

Appendix I

BENDING CHART MAINTENANCE

PIP001/PIPS001

BENDING CHART MAINTENANCE

1705/84 17:40:15

MACHINE CODE -> G (C = CONRAD G = GREENHILL)

RESIN FILLING ADJER -> 360

	DIAMETER IN INCHES										
	1.00	1.25	1.50	2.00	2.50	3.00	3.50	4.00	5.00	6.00	8.00 10.00
COPPER	13	14	15	17	19	29	30	32	43	44	
CO/NI	13	14	15	17	19	29	30	32	43	44	
CR STEEL	13	14	15	17	19	29	30	32	43	44	
CR STEEL	15	17	19	20	25	30	32	40	50	55	

8" & 10" Times are not established
Times = minutes

END OF REPORT FOR PIP001/PIPS001

1/06/84 12:40:36

PIP002/PIPSC002

FABRICATION CHART MAINTENANCE

MATERIAL CODE -> 0 (0=BRONZE, 5=STEEL)

SIZE IN INCHES	JOINT	FLANGES	G LITS	CUT
.50	8	31	23	11
.75	10	39	25	11
1.00	11	39	26	11
1.25	13	41	27	11
1.50	14	46	27	11
2.00	17	53	32	11
2.50	18	54	36	11
3.00	19	57	37	11
3.50	20	64	38	11
4.00	50	137		11
5.00	52	145		11
5.00	67	198		11
6.00	107	277		11
10.00	147	361		11

CND 1481089 CND 1481089 08/08/84

Times = Minutes

PI-0077-125007 W/O DETAIL INSTALLATION 12/09/83 12:42:42

CONT HULL W/OY A.O. NO. DTL DATE
 2550 0031 0106 255 214 10694 (LEAVE DTL BLANK TO DISPLAY ALL)

DTL RV	SIS RV	TYPE	INSTALLED	LOC / PALETTE	SPECIAL INFO	DATE	NOTE
EAA	F		Y	BT A1228A		12/09/83	
EAB	D		Y	BT A1228A		12/09/83	
EAC	C		Y	BT A1228A		12/09/83	
EAD	D		Y	BT A1228A		12/09/83	
EAE	C		Y	BT A1228A		12/09/83	
EAF	C		Y	BT A1228A		12/09/83	
EAG	C		Y	BT A1228A		12/09/83	
EAH	D		Y	BT A1228A		12/12/83	
EAI	F		Y	BT A1228A		12/12/83	
EAJ	D		Y	BT A1228A		12/09/83	
EAL	C		Y		HOLD	12/09/83	
EAM	F		Y	F A1228A		12/09/83	
EAN	C		Y		HOLD	12/09/83	
EAO	F		Y	BT A1228A		12/09/83	
EAP	F		Y		HOLD	12/10/83	
EAT	C		Y		HOLD		

END INST LOG. END LOG LOGS. 12/09/83

Lists all details installed and what were installed.

REP00037P1P50000 W.O. DETAIL UARCO MAINTENANCE 1/05/84 12:11:40

CONT	HULT	W.O. NO.	DATE	DTI	(LEAVE BLANK TO SELECT ALL)					ROLL	
7500	0000	0100	210	210	10000					ERR.	
R	R	DET	FA	INS							
DTI	V	SIS	V	INS	INS	TAL	LOC	ACT	UARCO	DATE	SPECIAL INFO
BAA	F			Y	Y	Y	Y	BT	A1031A	265093	7/28/83
BAB	D			N	Y	Y	Y	BT	A1031A	265093	7/28/83
BAC	C			N	Y	Y	Y	BT	A1031A	265093	7/28/83
BAD	D			Y	Y	Y	Y	BT	A1031A	273390	7/28/83
BAE	C			Y	Y	Y	Y	BT	A1031A	265075	7/28/83
BAF	C			N	Y	Y	Y	BT	A1031A	265075	7/28/83
BAG	C			N	Y	Y	Y	BT	A1031A	265093	7/28/83
BAH	C			N	Y	Y	Y	BT	A1031A	265093	7/28/83
BAI	F			Y	Y	Y	N	BT	A1031A	265093	7/28/83
BAJ	B			N	Y	Y	Y	BT	A1031A	265093	7/28/83
BAL	C			N	Y	N	N				405F
BAM	D			N	Y	Y	Y	BT	A1031A	265093	7/28/83
BAN	C			N	Y	N	N				405F
BAO	F			N	Y	Y	L	SP	A1031A	330043	12/22/83
BAP	C			N	Y	N	N				405F
BAQ	C			N	Y	N	N				405F

UPDATE of movement of details by UARCO's.
Updated daily.